Space Weather Technical Forecast

Issued on Monday, 19 February 2024 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares. Low confidence of CME arrival on 19 or 20 February.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Low solar activity through the period, with a peak C6.7 flare at 19/0940UTC from AR3590, which is emerging across the eastern limb. This region is still rotating fully onto the visible disc, but based on recent activity and observation of magnetic looping could be a relatively complex feature. AR3583 is rotating towards the western limb, and is still a large complex beta-gamma region. AR3586 in the north-centre disc has evolved slightly from a simple alpha region and is developing Beta characteristics. The remaining regions, out of five in total as simple and currently benign. A CME observed leaving the northeast of the Sun early on 19 February is not considered to be Earth-directed.

Solar Wind / Geomagnetic Activity: Slow wind speeds observed at L1 by ACE have followed a declining trend and are now below 300km/s in an ambient solar wind environment, with density below average. Total interplanetary magnetic field strength has weakened throughout and has fallen to 4nT. The north-south component, Bz, has oscillated weakly. Phi angle was resolutely positive (away from the Sun). Geomagnetic activity has been Quiet.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was just above background. Electron flux (greater than 2MeV) has been at background with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed fluence at 19/0000UTC was 9.36e5 pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Mainly Low activity is expected, with a risk of Moderate activity from either of the regions close to the northwest or southwest limb. A previously active returning region could rotate onto the southeast limb from 21 February.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 16 February may glance the Earth either on 19 or 20 February, but with low confidence. Otherwise solar wind speeds are expected to remain at ambient levels, with no high speed streams forecast to connect with the Earth. Geomagnetic activity is forecast to be mainly Quiet, with a slight chance of Unsettled or Active intervals on 19 or 20 February due to the potential CME arrival.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux will continue to gradually ease to background, but with a slight chance of further enhancement on day 19-20 February from any significant flares occur from AR3576 just over the limb. High energy electron flux (greater than 2MeV) is expected to remain at background levels. The associated 24-hour electron fluence is expected to stay below the Active threshold.

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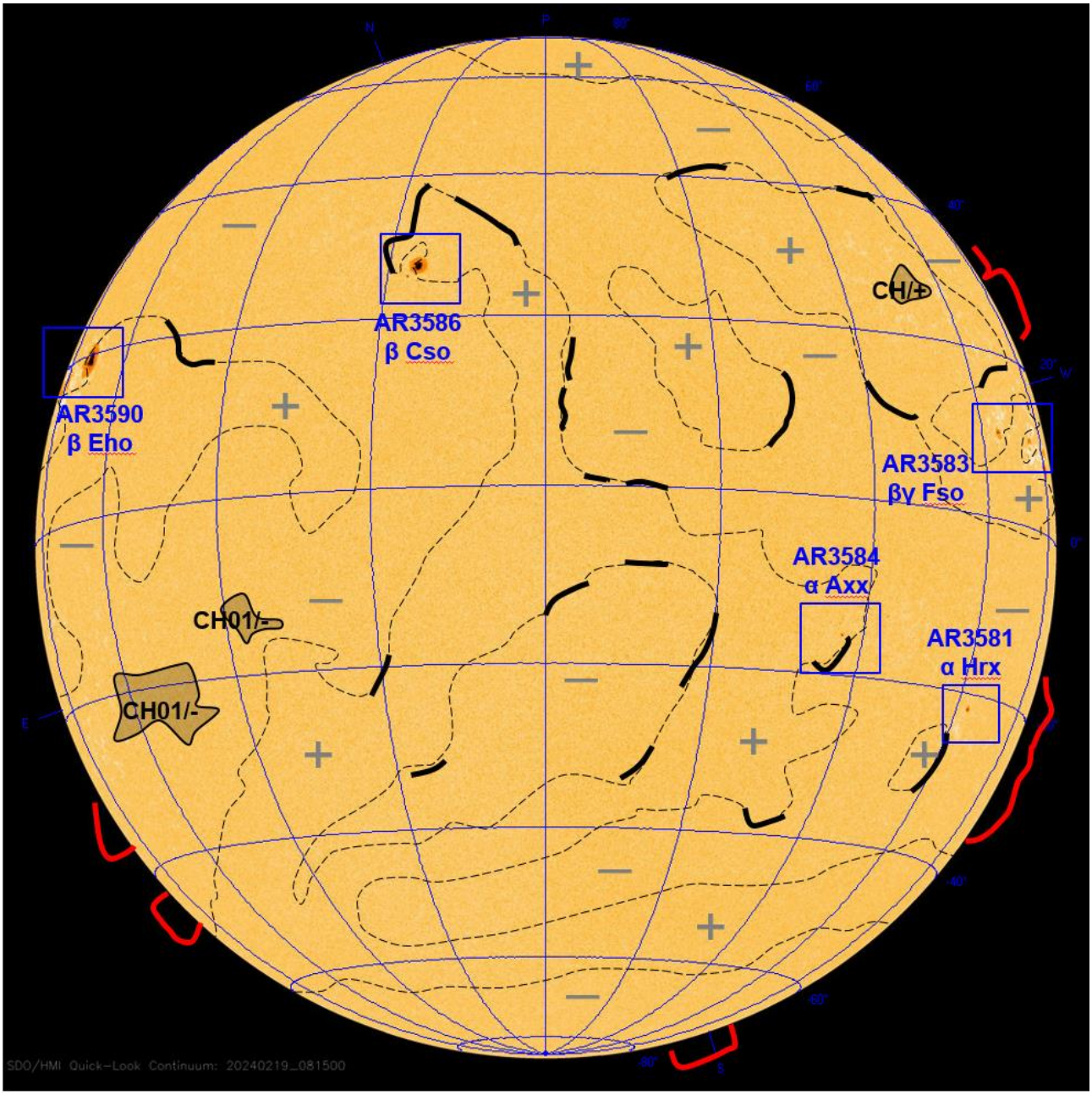
Figure 1. Solar Analysis Valid 19/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one potentially Earth-directed CME in the forecast. This is a filament eruption which left the north-centre disc on 16 February and is expected to arrive at earth either later on 19 or during 20 February.

Otherwise, solar wind speeds are expected to remain at ambient levels. No significant coronal holes are present on the visible disc, with one feature in the northwest quadrant considered too far north to affect the Earth.

Geomagnetic activity is forecast to be mainly Quiet, with a slight chance of Active or G1/Minor Storms through 19 and 20 February due to the risk of the CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0755	Nil	Filament	NW	770 km/s	19/1800	Low confidence of a glancing impact

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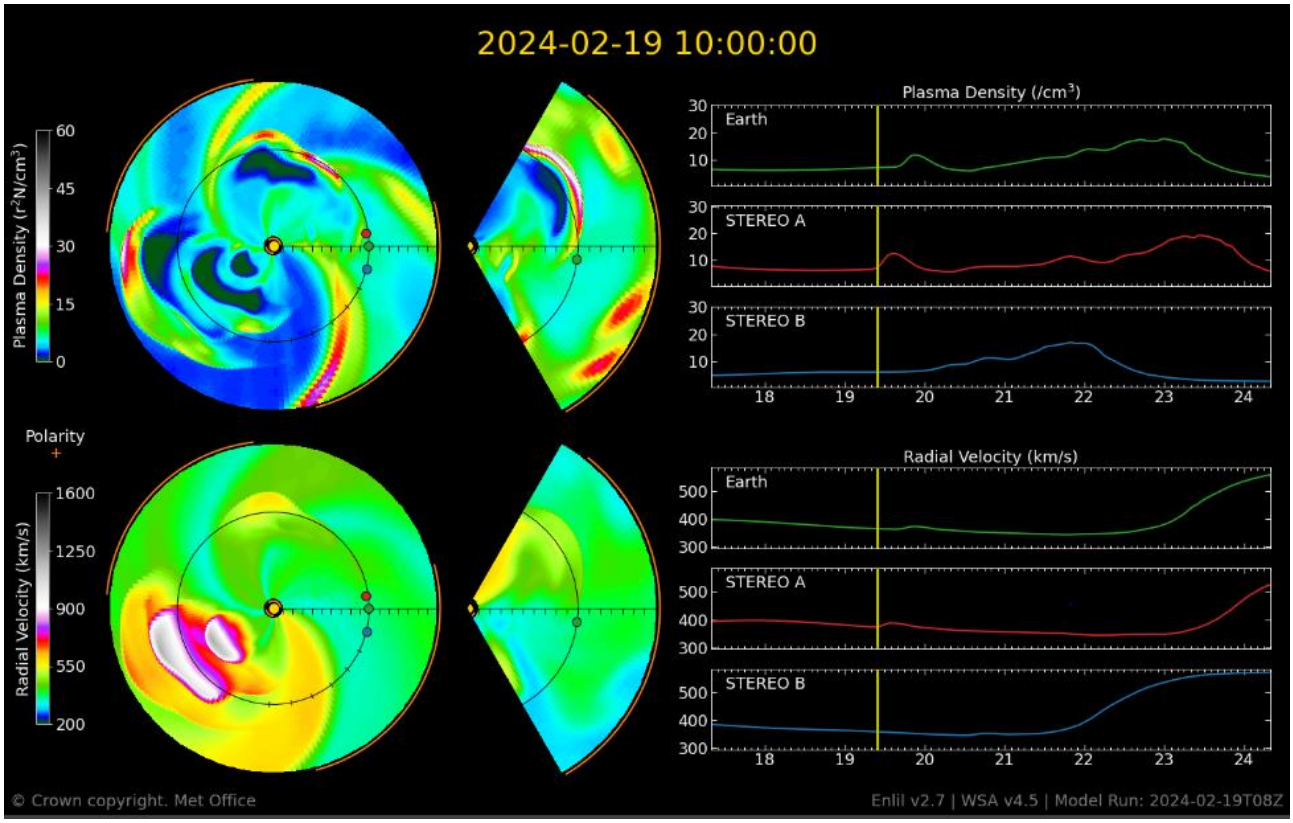
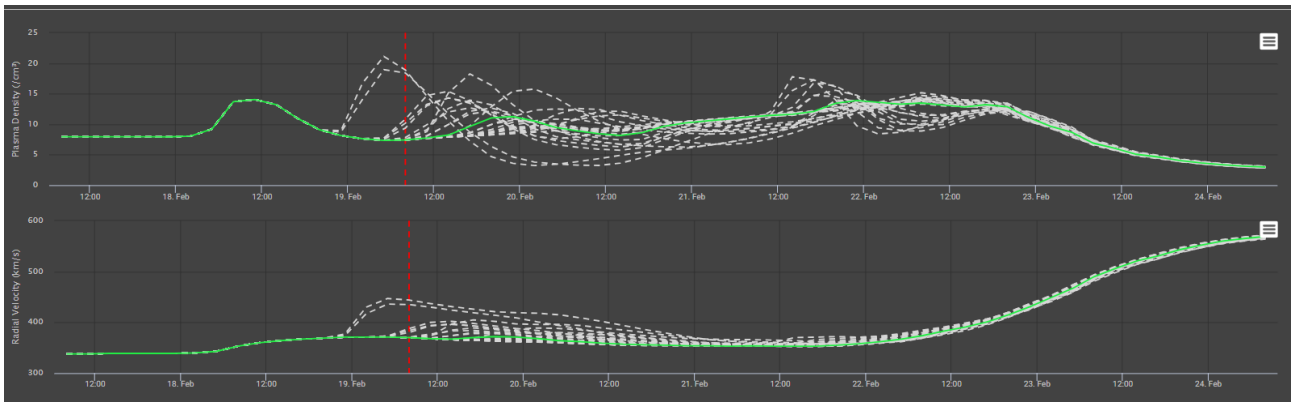
Figure 2: Enlil and Enlil ensemble forecast showing range of time of potential CME glancing impact through 19 and 20 February.





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Radio Blackouts - X-Ray Flares:
Low solar activity is expected throughout the period, but with an increasing likelihood of Moderate activity, due to a large region rotating onto the eastern limb.

AR3583 is approaching the western limb but still appears relatively complex and will still present a flare risk, albeit decreasing as it crosses the limb. AR3576, just across the southwest limb could still produce visible flares during 19 and 20 February. AR3590 on the eastern limb appears to a large, complex region, but will not be fully analysed until the entire region rotates onto the visible disc. However based on a preliminary analysis, this region is likely to increase the risk of M-class flares. The remaining regions appear stable, although AR3586 seems to be evolving some negative polarity spots and will be monitored. Ex-AR3575 is also expected to rotate onto the southeast limb from around 21 February and could present an increased flare risk.

Based on the balance between the declining risk from AR3576 and AR3583 along with the increasing risk from AR3590, a steady trend of solar activity risk is maintained through the next four days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16 X-ray flux. The recent increase in activity has been attributed to AR3590 on the eastern limb.

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Solar Radiation Storms - (High Energy Protons):

GOES 18 high energy (greater than 10MeV) protons have settled close to background levels in the past 24 hours. AR3576 will continue to give a decreasing risk for further proton enhancements as it moves across the far-side. The current regions on the Earth-facing disc have a lower chance of notable flares, and are currently considered unlikely sources of further solar storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to be muted through much of the period, with the only source of enhancements possible from a potential CME arrival on 19 or 20 February. This is forecast to be a glancing blow, with limited charging of the electron belts. As such mainly Moderate and occasional high levels on diurnal highs possible, but considered unlikely given the low confidence in the potential CME arrival.

Consequently, the electron fluence values are likely to remain well below the Active threshold throughout.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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